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Description

System and method for condition-based maintenance

5   The invention relates to a system and a method for condition-based
maintenance of machines, installations and operating means.

WO 01/59972 A2 describes a method for the maintenance of components.
By means of the method it is determined that a certain component has
10   to be maintained. A maintenance process with at least one
maintenance order is automatically selected, in order to perform
this maintenance. The maintenance process is administered and
monitored on a maintenance server.

15   From EP 0 822 473 A2, a system for the maintenance of dispersed
industrial installations is known. In this case, the industrial
installations in dispersed factories are monitored by host
computers. Each of these host computers is connected via the
Internet to a management host computer at the supplier end. The host
20   computer at the customer end transmits fault messages from the
industrial installations to the supplier. The host computer at the
supplier end then provides information on possible countermeasures
to the host computer at the customer end.

25   WO 00/62138 describes a method and a system for the performance of
maintenance of a production installation, particularly in the paper
industry. In this case, information on the production process is
provided to a remote service unit, where this information is
collected and analyzed. The transmission between the production
30   installation and the service unit takes place via the Internet, with
the particular internal data networks being separated from the
Internet itself by firewalls.

From US 6,317,701 B1, a maintenance system is known whereby data is
35   transmitted from intelligent field devices to a local maintenance
management system. The collected data is transmitted via the
Internet to a global maintenance server.

The object of the invention is to provide a universal solution for
condition-based maintenance, particularly of dispersed technical
installations.

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The object is achieved by a system for condition-based maintenance
of at least one decentralized technical installation, with recording
means for recording condition values of the technical installation,
with transmission means for transmission of the recorded condition
10 values to a central maintenance management system that has a first
means for evaluation of the condition values and a second means for
generation of maintenance orders relative to the results of the
evaluation of the condition values.

15 This object is achieved by a method for condition-based maintenance
of at least one decentralized technical installation by means of
which condition values of the technical installation are recorded by
recording means, with the recorded condition values being
transmitted to a central maintenance management system by
20 transmission means, whereby the central maintenance management
system evaluates the condition values with first means and with
second means generates maintenance orders relative to a result of
the evaluation of the condition values.

25 More and more machines, installations and operating means are sold
with a maintenance contract. Part of this maintenance is condition-
based maintenance, whereby maintenance is not activated until a
specific condition is reached. The invention is based on the idea of
transmitting the condition data of the installations installed at
30 the customer to a central maintenance management system of the
machine manufacturer for evaluation. This system can also similarly
be used within a company as part of a central condition-based
maintenance. In this case, the condition-based maintenance is set
up, monitored, implemented and/or documented by a central
35 organization with the aid of the maintenance management system. To
be able to administer a system centrally for condition-based
maintenance, the recorded condition values are transmitted to the

center. The maintenance orders can then be generated, planned and
documented in the maintenance management system in the center.

In accordance with an advantageous embodiment of the invention, a
5   second means of the central maintenance management system is
provided to generate maintenance orders corresponding to predefined
rules. This enables a particularly fast and effective generation of
maintenance orders. The predefined rules in this case are present in
the form of permanent links, as a knowledge basis, or also in the
10   form of adaptable expert systems.

For ongoing support of the condition-based maintenance, the central
maintenance management system has a third means for the
implementation, monitoring and/or documentation of the generated
15   maintenance orders. A maintenance management system set up in this
way goes far beyond maintenance servers known according to the prior
art.

Advantageously, the transmission means for transmission of the
20   recorded condition values is provided by e-mail. Transmission by e-
mail has the advantage that no continuously-open Internet connection
is necessary. The e-mail transmission is a tried and tested reliable
standard mechanism on the Internet. The transmission and reception
processes are decoupled with regard to time without a risk of
25   transmitted condition values being lost.

In accordance with a further advantageous embodiment of the
invention, the transmission means for transmission of the recorded
condition values is provided by means of http transfer. At the
30   installation end the recorded condition values are thus stored in a
suitably configured Internet page that can then be called up by the
central maintenance management system at any time or at previously
defined times.

35   Advantageously, the recording means is part of a stored program
control system or a SCADA system.

In a further advantageous embodiment of the invention, the
maintenance management system is linked to an industrial framework
system or connected into such a system.

5   The invention is explained in more detail in the following with the
aid of illustrations showing examples of embodiment.

These are as follows:

10   Fig. 1   A system for condition-based maintenance of a
decentralized technical installation

Fig. 2   A principle representation of such a system using various
means of transmission of the recorded condition values

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Fig. 3   The transmission of the recorded condition values by
means of e-mail communication

Fig. 4   The transmission of the recorded condition values by
20   means of http communication.

Fig. 1 shows a system for condition-based maintenance of a
decentralized technical installation 1. By means of the recording
means 2, condition values (tag values) of the technical installation
25   1 are recorded that are transmitted by a transmission means 3,4 to a
central maintenance management system 5. The maintenance management
system 5 contains a first means 6 for evaluation of the condition
values and a second means 7 for generation of maintenance orders 8
relative to a result of the evaluation of the condition values. The
30   evaluation of the condition values consists, for example, of an
evaluation to determine whether the particular condition value is
within specified limiting values. The second means 7 can, for
example, be provided for generation of maintenance orders 8
corresponding to predefined rules. A maintenance order 8 of this
35   kind determines and describes, e.g. what maintenance activities are
to be performed (e.g. oil change), what resources (materials,

personnel, tools, etc.) are required and what time limits are to be
maintained, etc.

Fig. 2 shows a general arrangement of a system for condition-based
5   maintenance of at least one decentralized technical installation
with various transmission means being used to transmit the recorded
condition values. In the example of an embodiment, a decentralized
technical installation is controlled by a stored program controller
20 (SPC) or by a SCADA (Supervisory Control and Data Acquisition
10   System) 21. Various process parameters are available in the SPC or
SCADA system. Part of these process parameters (e.g. operating
hours, switching cycles, pressure, temperature, etc.) can describe
the condition of the decentralized technical installation or the
condition of the parts of the installation relative to the
15   maintenance measures required. These process parameters are
transmitted to a central maintenance management system 23 for
maintenance evaluation in a center, at specific intervals or
according to previously defined events. As part of a cost-effective
and standardized total solution, the transmission of the condition
20   values takes place via the Internet 22 by means of e-mail
communication 24,26,28 or by means of http communication 25,27,29.
The condition values are imported directly into the maintenance
management system 23 and evaluated by same, i.e. the maintenance
management system 23 generates maintenance orders or triggers
25   maintenance alarms. The described global maintenance scenario
represents a universal solution from data recording using automated
technology up to evaluation in the maintenance management system 23
and the associated data transmission.

30   Fig. 3 shows the transmission of the recorded condition values by
means of e-mail communication. A personal computer (PC) in the
decentralized technical installation to be maintained at the
customer end, a so-called maintenance client 40 has an interface 41,
e.g. a modem, LAN or Internet access. The maintenance client 40 at
35   the customer end transmits maintenance data and alarms to the global
central maintenance server 42. Furthermore, the maintenance client
40 enables online importing directly from the SPC, by means of an

OPC server (OLE for Process Control Server), offline importing using
manual input into a web GUI (Graphical User Interface) and web
access to a local, installation-specific maintenance management
system. At the supplier end, a maintenance server 42 realizes the
5   functions of the maintenance management system. The maintenance
server 42 also has an interface 43. Communication between the
maintenance client 40 and maintenance server 42 takes place via the
Internet or through a Local Area Network (LAN). By means of an e-
mail connection 44, the maintenance client 40 supplies XML tags to
10   the maintenance server 42. A LAN or Internet connection enables
online/remote engineering 45 (application sharing) of the
maintenance client 40 at the customer end. The maintenance client 40
can access the maintenance server 42 via a LAN/Internet connection
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Fig. 4 shows the transmission of the recorded condition values by
means of http communication. A personal computer (PC) in the
decentralized technical installation to be maintained at the
customer end, a so-called maintenance client 60 has an interface 61,
20   e.g. a modem, LAN or Internet access. At the supplier end, a
maintenance server 62 realizes the functions of the maintenance
management system. The maintenance server 62 also has an interface
63. Communication between the maintenance client 60 and maintenance
server 62 takes place via the Internet or through a Local Area
25   Network (LAN). By means of an http connection 64, the maintenance
server 62 can request XML tags from the maintenance client 60. A LAN
or Internet connection enables online engineering 65 (application
sharing). The maintenance client 60 can access the maintenance
server 62 via a LAN/Internet connection 66.

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To sum up, the invention thus relates to a system and a method for
condition-based maintenance of at least one decentralized technical
installation 1 or of machines and operating means of such an
installation 1. The system includes recording means 2 for recording
35   condition values of the technical installation 1 and transmission
means 3,4 for the transmission of the recorded condition values to a
central maintenance management system 5, that has a first means 6

for evaluation of the condition values and a second means 7 for
generation of maintenance orders 8 relative to a result of the
evaluation of the condition values. The condition-based maintenance
Condition Based Maintenance takes place particularly by means of a
5   global maintenance system 5 by transmission of condition values from
an automated system (e.g. SPC, SCADA) via e-mail or http transfer.